

# Physics

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(Chapter 1) (Electric Charges and Fields)  
(Class 12)

## Question 1.1:

What is the force between two small charged spheres having charges of  $2 \times 10^{-7}\text{C}$  and  $3 \times 10^{-7}\text{C}$  placed 30 cm apart in air?

## Answer 1.1:

Repulsive force of magnitude  $6 \times 10^{-3}\text{ N}$

Charge on the first sphere,  $q_1 = 2 \times 10^{-7}\text{ C}$

Charge on the second sphere,  $q_2 = 3 \times 10^{-7}\text{ C}$

Distance between the spheres,  $r = 30\text{ cm} = 0.3\text{ m}$

Electrostatic force between the spheres is given by the relation  $F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}$

Where,  $\epsilon_0$  = Permittivity of free space and  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9\text{ Nm}^2\text{C}^{-2}$

Therefore, force  $F = \frac{9 \times 10^9 \times 2 \times 10^{-7}}{(0.3)^2} = 6 \times 10^{-3}\text{ N}$

Hence, force between the two small charged spheres is  $6 \times 10^{-3}\text{ N}$ . The charges are of same nature. Hence, force between them will be repulsive.

## Question 1.2:

The electrostatic force on a small sphere of charge  $0.4\text{ }\mu\text{C}$  due to another small sphere of charge  $-0.8\text{ }\mu\text{C}$  in air is  $0.2\text{ N}$ .

(a) What is the distance between the two spheres?

(b) What is the force on the second sphere due to the first?

## Answer 1.2:

(a) Electrostatic force on the first sphere,  $F = 0.2\text{ N}$

Charge on this sphere,  $q_1 = 0.4\text{ }\mu\text{C} = 0.4 \times 10^{-6}\text{ C}$

Charge on the second sphere,  $q_2 = -0.8\text{ }\mu\text{C} = -0.8 \times 10^{-6}\text{ C}$

Electrostatic force between the spheres is given by

$$F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}$$

Where,  $\epsilon_0$  = Permittivity of free space and  $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9\text{ Nm}^2\text{C}^{-2}$

Therefore,

$$r^2 = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{F} = \frac{0.4 \times 10^{-6} \times 8 \times 10^{-6} \times 9 \times 10^9}{0.2} = 144 \times 10^{-4}$$

$$\Rightarrow r = \sqrt{144 \times 10^{-4}}$$

$$= 12 \times 10^{-2}$$

$$= 0.12\text{ m}$$

The distance between the two spheres is  $0.12\text{ m}$ .

(b) Both the spheres attract each other with the same force. Therefore, the force on the second sphere due to the first is  $0.2\text{ N}$ .

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